CLAIMS:

1. A carrier comprising:

a magnetic core material; and

a layer located on a surface of the magnetic core material,

wherein the carrier satisfies the following relationships (1) to (3):

$$0.90 \leqq (\sigma a/\sigma b) < 1.00 \quad (1)$$

$$200 \leqq (\sigma b \cdot \rho c) \leqq 400 \quad (2)$$

$$10 \leqq (\sigma b/\rho c) \leqq 20 \quad (3),$$

wherein σb represents a magnetization (emu/g) of the carrier at 1,000 Oe, ρc represents a true specific gravity of the carrier, and σa represents a magnetization of the carrier determined by the following method including:

(1) magnetically holding the carrier on a cylindrical sleeve having a magnetic pole area located over a magnetic pole and having a peak magnetic flux density of 100 mT in a direction perpendicular to an axis of the cylindrical sleeve;

(2) rotating the cylindrical sleeve around the axis thereof for about 30 min;

(3) removing the carrier from the magnetic pole area by applying a force which is three times as much as a weight of the carrier in the direction perpendicular to the axis of the cylindrical sleeve; and

(4) measuring a magnetization at 1,000 Oe to determine the magnetization σa,

wherein the carrier has a weight-average particle diameter (D4) of about 25 to about 65 μm and includes carrier particles having a weight-average particle diameter not greater than about 12 μm in an amount not greater than about 0.3 % by weight,

wherein a ratio (D4/D1) between the weight-average particle diameter (D4) and a number-average particle diameter of the carrier (D1) is about 1 to about 1.3, and

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wherein an electric resistance R is about 1.0×10^9 to about $1.0 \times 10^{11} \ \Omega \cdot cm$ when an

AC voltage represented by the following formula (4) is applied at a frequency of 1,000 Hz to

a magnetic brush of the carrier is formed between parallel plate electrodes having a gap of d

mm such that magnetic brush has a space occupancy of about 40 %:

$E \ (V) = 250 \times d$ (4),

wherein d is 0.40±0.05 mm and E is a peak voltage.

2. The carrier of Claim 1, wherein the carrier has an average surface vertical interval

of about 0.1 to about 2.0 µm.

3. The carrier of Claim 1, wherein the layer comprises a resin and an insulative

inorganic particulate material.

4. The carrier of Claim 1, wherein the magnetic core material includes a particulate

ferrite.

5. The carrier of Claim 1, wherein the magnetic core material includes a particulate

material in which a magnetic material is dispersed in a resin.

6. A two-component developer comprising:

a carrier comprising:

    a magnetic core material; and

    a layer located on a surface of the magnetic core material,

    wherein the carrier satisfies the following relationships (1) to (3):

    $0.90 \leq (\sigma a / \sigma b) < 1.00$ (1)

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$$200 \leq (\sigma b \cdot \rho c) \leq 400 \quad (2)$$

$$10 \leq (\sigma b / \rho c) \leq 20 \quad (3),$$

wherein σb represents a magnetization (emu/g) of the carrier at 1,000 Oe, ρc represents a true specific gravity of the carrier, and σa represents a magnetization of the carrier determined by the following method including:

(1) magnetically holding the carrier on a cylindrical sleeve having a magnetic pole area located over a magnetic pole and having a peak magnetic flux density of 100 mT in a direction perpendicular to an axis of the cylindrical sleeve;

(2) rotating the cylindrical sleeve around the axis thereof for about 30 min;

(3) removing the carrier from the magnetic pole area by applying a force which is three times as much as a weight of the carrier in the direction perpendicular to the axis of the cylindrical sleeve; and

(4) measuring a magnetization at 1,000 Oe to determine the magnetization σa,

wherein the carrier has a weight-average particle diameter (D4) of about 25 to about 65 μm and includes carrier particles having a weight-average particle diameter not greater than about 12 μm in an amount not greater than about 0.3 % by weight,

wherein a ratio (D4/D1) between the weight-average particle diameter (D4) and a number-average particle diameter of the carrier (D1) is about 1 to about 1.3, and

wherein an electric resistance R is about 1.0×10^9 to about 1.0×10^{11} Ω · cm when an AC voltage represented by the following formula (4) is applied at a frequency of 1,000 Hz to a magnetic brush of the carrier is formed between parallel plate electrodes having a gap of d mm such that magnetic brush has a space occupancy of about 40 %:

$$E (V) = 250 \times d \quad (4),$$

wherein d is 0.40±0.05 mm and E is a peak voltage; and

a toner comprising:

a binder resin; and

a colorant.

7. The two-component developer of Claim 6, wherein the two-component developer comprises the toner in an amount of about 2 to about 12 % by weight.

8. The two-component developer of Claim 6, wherein the toner further comprises a release agent.

9. The two-component developer of Claim 6, wherein the toner has a weight-average particle diameter of about 4 to about 10 μm.

10. An image developer comprising:

a charger configured to frictionally charge a toner;

a rotatable holder including a magnetic filed generator, which is configured to hold a two-component developer comprising:

a carrier comprising:

a magnetic core material; and

a layer located on a surface of the magnetic core material,

wherein the carrier satisfies the following relationships (1) to (3):

$$0.90 \leqq (\sigma a/\sigma b) < 1.00 \quad (1)$$

$$200 \leqq (\sigma b \cdot \rho c) \leqq 400 \quad (2)$$

$$10 \leqq (\sigma b/\rho c) \leqq 20 \quad (3),$$

wherein σb represents a magnetization (emu/g) of the carrier at 1,000 Oe, ρc represents a true specific gravity of the carrier, and σa represents a magnetization of the carrier determined by the following method including:

(1) magnetically holding the carrier on a cylindrical sleeve having a magnetic pole area located over a magnetic pole and having a peak magnetic flux density of 100 mT in a direction perpendicular to an axis of the cylindrical sleeve;

(2) rotating the cylindrical sleeve around the axis thereof for about 30 min;

(3) removing the carrier from the magnetic pole area by applying a force which is three times as much as a weight of the carrier in the direction perpendicular to the axis of the cylindrical sleeve; and

(4) measuring a magnetization at 1,000 Oe to determine the magnetization σa,

wherein the carrier has a weight-average particle diameter (D4) of about 25 to about 65 μm and includes carrier particles having a weight-average particle diameter not greater than about 12 μm in an amount not greater than about 0.3 % by weight,

wherein a ratio (D4/D1) between the weight-average particle diameter (D4) and a number-average particle diameter of the carrier (D1) is about 1 to about 1.3, and

wherein an electric resistance R is about 1.0×10^9 to about 1.0×10^{11} Ω · cm when an AC voltage represented by the following formula (4) is applied at a frequency of 1,000 Hz to a magnetic brush of the carrier is formed between parallel plate electrodes having a gap of d mm such that magnetic brush has a space occupancy of about 40 %:

$$E (V) = 250 \times d \qquad (4),$$

wherein d is 0.40±0.05 mm and E is a peak voltage; and

a toner comprising:

a binder resin; and

a colorant; and

an image bearer configured to bear an electrostatic latent image thereon, wherein the electrostatic latent image is developed with the two-component developer at a developing area located between the image bearer and the rotatable holder,

wherein a maximum magnetic flux density B (mT) at the developing area in a normal direction of a surface of the rotatable holder satisfies the following relationship (5):

$$(15{,}000/(\sigma a \cdot \rho c)) \leqq B \leqq (50{,}000/(\sigma b \cdot \rho c)) \quad (5).$$

11. The image developer of Claim 10, wherein a minimum distance between the rotatable holder and the image bearer is about 0.30 to about 0.80 mm.

12. The image developer of Claim 10, further comprising a voltage applicator configured to apply a DC bias voltage to the rotatable holder.

13. The image developer of Claim 12, wherein the voltage applicator applies a DC bias voltage overlapped with an AC voltage to the rotatable holder.

14. The image developer of Claim 10, further comprising a recycler comprising:

a cleaner configured to clean the image bearer by collecting the toner remaining on a surface of the image bearer; and

a returner configured to return the collected toner to the rotatable holder.

15. An image forming apparatus comprising:

a plurality of image developers configured to develop an electrostatic latent image with a developer to form a toner image;

a transferer configured to transfer the toner image onto a transfer medium; and

a fixer configured to fix the toner image on the transfer medium,

wherein the plurality of image developers includes an image developer comprising:

a charger configured to frictionally charge a toner;

a rotatable holder including a magnetic filed generator, which is configured to hold a two-component developer comprising:

a carrier comprising:

a magnetic core material; and

a layer located on a surface of the magnetic core material,

wherein the carrier satisfies the following relationships (1) to (3):

$$0.90 \leq (\sigma a / \sigma b) < 1.00 \quad (1)$$

$$200 \leq (\sigma b \cdot \rho c) \leq 400 \quad (2)$$

$$10 \leq (\sigma b / \rho c) \leq 20 \quad (3),$$

wherein σb represents a magnetization (emu/g) of the carrier at 1,000 Oe, ρc represents a true specific gravity of the carrier, and σa represents a magnetization of the carrier determined by the following method including:

(1) magnetically holding the carrier on a cylindrical sleeve having a magnetic pole area located over a magnetic pole and having a peak magnetic flux density of 100 mT in a direction perpendicular to an axis of the cylindrical sleeve;

(2) rotating the cylindrical sleeve around the axis thereof for about 30 min;

(3) removing the carrier from the magnetic pole area by applying a force which is three times as much as a weight of the carrier in the direction perpendicular to the axis of the cylindrical sleeve; and

(4) measuring a magnetization at 1,000 Oe to determine the magnetization σa,

wherein the carrier has a weight-average particle diameter (D4) of about 25 to about 65 μm and includes carrier particles having a weight-average particle diameter not greater than about 12 μm in an amount not greater than about 0.3 % by weight,

wherein a ratio (D4/D1) between the weight-average particle diameter (D4) and a number-average particle diameter of the carrier (D1) is about 1 to about 1.3, and

wherein an electric resistance R is about 1.0×10^9 to about 1.0×10^{11} Ω · cm when an AC voltage represented by the following formula (4) is applied at a frequency of 1,000 Hz to a magnetic brush of the carrier is formed between parallel plate electrodes having a gap of d mm such that magnetic brush has a space occupancy of about 40 %:

$$E (V) = 250 \times d \qquad (4),$$

wherein d is 0.40±0.05 mm and E is a peak voltage; and

a toner comprising:

a binder resin; and

a colorant; and

an image bearer configured to bear an electrostatic latent image thereon, wherein the electrostatic latent image is developed with the two-component developer at a developing area located between the image bearer and the rotatable holder,

wherein a maximum magnetic flux density B (mT) at the developing area in a normal direction of a surface of the rotatable holder satisfies the following relationship (5):

$$(15,000/(\sigma a \cdot \rho c)) \leqq B \leqq (50,000/(\sigma b \cdot \rho c)) \qquad (5).$$

16. A process cartridge comprising a member selected from the group comprising photoreceptors, chargers, image developers, and cleaners, wherein the image developers include an image developer comprising:

a charger configured to frictionally charge a toner;

a rotatable holder including a magnetic filed generator, which is configured to hold a two-component developer comprising:

a carrier comprising:

a magnetic core material; and

a layer located on a surface of the magnetic core material,

wherein the carrier satisfies the following relationships (1) to (3):

$$0.90 \leqq (\sigma a/\sigma b) < 1.00 \quad (1)$$

$$200 \leqq (\sigma b \cdot \rho c) \leqq 400 \quad (2)$$

$$10 \leqq (\sigma b/\rho c) \leqq 20 \quad (3),$$

wherein σb represents a magnetization (emu/g) of the carrier at 1,000 Oe, ρc represents a true specific gravity of the carrier, and σa represents a magnetization of the carrier determined by the following method including:

(1) magnetically holding the carrier on a cylindrical sleeve having a magnetic pole area located over a magnetic pole and having a peak magnetic flux density of 100 mT in a direction perpendicular to an axis of the cylindrical sleeve;

(2) rotating the cylindrical sleeve around the axis thereof for about 30 min;

(3) removing the carrier from the magnetic pole area by applying a force which is three times as much as a weight of the carrier in the direction perpendicular to the axis of the cylindrical sleeve; and

(4) measuring a magnetization at 1,000 Oe to determine the

magnetization σa,

wherein the carrier has a weight-average particle diameter (D4) of

about 25 to about 65 μm and includes carrier particles having a weight-

average particle diameter not greater than about 12 μm in an amount not

greater than about 0.3 % by weight,

wherein a ratio (D4/D1) between the weight-average particle diameter

(D4) and a number-average particle diameter of the carrier (D1) is about 1 to

about 1.3, and

wherein an electric resistance R is about 1.0×10^9 to about 1.0×10^{11}

$\Omega \cdot cm$ when an AC voltage represented by the following formula (4) is

applied at a frequency of 1,000 Hz to a magnetic brush of the carrier is formed

between parallel plate electrodes having a gap of d mm such that magnetic

brush has a space occupancy of about 40 %:

E (V) = 250 × d   (4),

wherein d is 0.40±0.05 mm and E is a peak voltage; and

a toner comprising:

a binder resin; and

a colorant; and

an image bearer configured to bear an electrostatic latent image thereon, wherein the

electrostatic latent image is developed with the two-component developer at a developing

area located between the image bearer and the rotatable holder,

wherein a maximum magnetic flux density B (mT) at the developing area in a normal

direction of a surface of the rotatable holder satisfies the following relationship (5):

$(15,000/(\sigma a \cdot \rho c)) \leqq B \leqq (50,000/(\sigma b \cdot \rho c))$ (5).

17. A carrier comprising:

a magnetic core material; and

a layer located on a surface of the magnetic core material,

wherein the carrier satisfies the following relationships (1) to (3):

$$0.90 \leqq (\sigma a/\sigma b) < 1.00 \quad (1)$$

$$200 \leqq (\sigma b \cdot \rho c) \leqq 400 \quad (2)$$

$$10 \leqq (\sigma b/\rho c) \leqq 20 \quad (3),$$

wherein σb represents a magnetization (emu/g) of the carrier at 1,000 Oe, ρc represents a true specific gravity of the carrier, and σa represents a magnetization of the carrier determined by the following apparatus including:

(1) means for magnetically holding the carrier on a cylindrical sleeve having a magnetic pole area located over a magnetic pole and having a peak magnetic flux density of 100 mT in a direction perpendicular to an axis of the cylindrical sleeve;

(2) means for rotating the cylindrical sleeve around the axis thereof for about 30 min;

(3) means for removing the carrier from the magnetic pole area by applying a force which is three times as much as a weight of the carrier in the direction perpendicular to the axis of the cylindrical sleeve; and

(4) means for measuring a magnetization at 1,000 Oe to determine the magnetization σa,

wherein the carrier has a weight-average particle diameter (D4) of about 25 to about 65 μm and includes carrier particles having a weight-average particle diameter not greater than about 12 μm in an amount not greater than about 0.3 % by weight,

wherein a ratio (D4/D1) between the weight-average particle diameter (D4) and a number-average particle diameter of the carrier (D1) is about 1 to about 1.3, and

wherein an electric resistance R is about 1.0×10^9 to about 1.0×10^{11} $\Omega \cdot$ cm when an AC voltage represented by the following formula (4) is applied at a frequency of 1,000 Hz to a magnetic brush of the carrier is formed between parallel plate electrodes having a gap of d mm such that magnetic brush has a space occupancy of about 40 %:

E (V) = 250 × d   (4),

wherein d is 0.40±0.05 mm and E is a peak voltage.

18. The carrier of Claim 17, wherein the carrier has an average surface vertical interval of about 0.1 to about 2.0 µm.

19. The carrier of Claim 17, wherein the layer comprises a resin and an insulative inorganic particulate material.

20. The carrier of Claim 17, wherein the magnetic core material includes a particulate ferrite.

21. The carrier of Claim 17, wherein the magnetic core material includes a particulate material in which a magnetic material is dispersed in a resin.